



ELECTRONIC INFORMATION DISCLOSURE STATEMENT

Electronic Version v18

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Title of
Invention

METHOD AND APPARATUS FOR ACHIEVING
TEMPERATURE UNIFORMITY AND HOT SPOT COOLING
IN A HEAT PRODUCING DEVICE

Application Number: 10/698304
Confirmation Number: 1389
First Named Applicant: Kenneth Goodson
Attorney Docket Number:
Search string: (4467861 or 4903761 or 5016090 or 5269372
or 5275237 or 5310440 or 5346000 or 5388635
or 5945217 or 6019165 or 6034872 or 6039114
or 6253832 or 6257320 or 6330907 or 6336497
or 6366462 or 6367544 or 6431260 or 6466442
or 6519151 or 6533029 or 6536516 or 6601643
or 6609560 or 6651735 or 20030213580).pn.

US Patent Documents

Note: Applicant is not required to submit a paper copy of cited US Patent Documents

init	Cite.No.	Patent No.	Date	Patentee	Kind	Class	Subclass
TM	1	4467861	1984-08-28	Kiseev et al.			
TM	2	4903761	1990-02-27	Cima			
TM	3	5016090	1991-05-14	Galyon et al.			
TM	4	5269372	1993-12-14	Chu et al.			
TM	5	5275237	1994-01-04	Rolfson et al.			
TM	6	5310440	1994-05-10	Zingher			
TM	7	5346000	1994-09-13	Schlitt			
TM	8	5388635	1995-02-14	Gruber et al.			
TM	9	5945217	1999-08-31	Hanrahan			
TM	10	6019165	2000-02-01	Batchelder			
TM	11	6034872	2000-03-07	Chrysler et al.			
TM	12	6039114	2000-03-21	Becker et al.			
TM	13	6253832	2001-07-03	Hallefalt	B1		
TM	14	6257320	2001-07-10	Wargo	B1		



15	6330907	2001-12-18	Ogushi et al.	B1
16	6336497	2002-01-08	Lin	B1
17	6366462	2002-04-02	Chu et al.	B1
18	6367544	2002-04-09	Calaman	B1
19	6431260	2002-08-13	Agonafer et al.	B1
20	6466442	2002-10-15	Lin	B2
21	6519151	2003-02-11	Chu et al.	B2
22	6533029	2003-03-18	Phillips	B1
23	6536516	2003-03-25	Davies et al.	B2
24	6601643	2003-08-05	Cho et al.	B2
25	6609560	2003-08-26	Cho et al.	B2
26	6651735	2003-11-25	Cho et al.	B2

US Published Applications

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init	Cite.No.	Pub. No.	Date	Applicant	Kind	Class	Subclass
1	1	20030213580	2003-11-20	Philpott et al.	A1		

Signature

Examiner Name	Date
<i>[Signature]</i>	6-07-05

FORM PTO-1449
(Modified)

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U.S. Department of Commerce
Patent and Trademark Office

Attorney Docket No.: COOL-01800

Serial No.: 10/698,304

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Use Several Sheets If Necessary)

Applicants: Kenneth Goodson et al.

(37 CFR § 1.98(b))

Filing Date: October 30, 2003

Group Art Unit: 1312

FOREIGN PATENTS OR PUBLISHED FOREIGN PATENT APPLICATIONS

		Document Number	Publication Date	Country / Patent Office	Class	Subclass	Translation	
							Yes	No
TM	AA	97212126.9	03/04/97	CN	BO1D	61/42		X
TM	AB	2000-277540	10/06/00	JP	H01L	21/50		X

OTHER DOCUMENTS (Including Author, Title, Date, Relevant Pages, Place of Publication)


TM	AC	Stephen C. Jacobson et al., "Fused Quartz Substrates for Microchip Electrophoresis", Analytical Chemistry, Vo. 67, No. 13, July 1, 1995, pages 2059-2063.						
TM	AD	Kendra V. Sharp et al., "Liquid Flows in Microchannels", 2002, Vol. 6, pages 6-1 to 6-38.						
TM	AE	Shuchi Shoji et al., "Microflow devices and systems", J. Microech. Microeng. 4 (1994), pages 157-171, printed in the U.K.						
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	AH	Gad Hetroni et al., "Nonuniform Temperature Distribution in Electronic Devices Cooled by Flow in Parallel Microchannels", IEEE Transactions on Components and Packaging Technologies, March 2001, Vol. 24, No. 1, pages 16-23.						
	AI	X. F. Peng et al., "Heat Transfer Characteristics of Water Flowing through Microchannels", Experimental Heat Transfer An International Journal, Vol. 7, No. 4, October-December 1994, pages 265-283.						
	AJ	Linan Jiang et al., "Forced Convection Boiling in a Microchannel Heat Sink", Journal of Microelectromechanical Systems, Vol. 10, No. 1, March 2001, pages 80-87.						
	AK	Muhammad M. Rahman et al., "Experimental Measurements of Fluid Flow and Heat Transfer in Microchannel Cooling Passages in a Chip Substrate", 1993, EEP-Vol. 4-2, Advances in Electronic Packages, pages 685-692.						
	AL	X. F. Peng et al., "Forced convection and flow boiling heat transfer for liquid flowing through Microchannels", 1993, Int. J. Heat Mass Transfer, Vol. 36, No. 14, pages 3421-3427.						
	AM	Lung-Jieh Yang et al., "A Micro Fluidic System of Micro Channels with On-Site Sensors by Silicon Bulk Micromachining", September 1999, Microfluidic Devices and Systems II, Vol. 3877, pages 267-272.						
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	AO	J. M. Cuta et al., "Fabrication and Testing of Micro-Channel Heat Exchangers", SPIE Microlithography and Metrology in Micromachining, Vol. 2640, 1995, pages 152-160.						
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	AQ	Linan Jiang et al., "Fabrication and characterization of a microsystem for a micro-scale heat transfer study", J. Micromech. Microeng. 9 (1999) pages 422-428, printed in the U.K.						
	AR	M. B. Bowers et al., "High flux boiling in low flow rate, low pressure drop mini-channel and micro-channel heat sinks", 1994, Int. J. Heat Mass Transfer, Vol. 37, No. 2, pages 321-332.						
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	AW	Issam Mudawar et al., "Enhancement of Critical Heat Flux from High Power Microelectronic Heat Sources in a Flow Channel", Journal of Electronic Packaging, September 1990, Vol. 112, pages 241-248.						
	AX	Nelson Kuan, "Experimental Evaluation of Micro Heat Exchangers Fabricated in Silicon", 1996, HTD-Vol. 331, National Heat Transfer Conference, Vol. 9, pages 131-136.						
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TM	BA	Snezana Konecni et al., "Convection Cooling of Microelectronic Chips", 1992, InterSociety Conference on Thermal Phenomena, pages 138-144.						

Examiner:

Date Considered:

EXAMINER:

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 6-27-05

FORM PTO-1449 (Modified)		U.S. Department of Commerce Patent and Trademark Office		Attorney Docket No.: COOL-01800	Serial No.: 10/698,304
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use Several Sheets If Necessary)				Applicants: Kenneth Goodson et al.	
(37 CFR § 1.98(b))				Filing Date: October 30, 2003	Group Art Unit: 1312
OTHER DOCUMENTS (Including Author, Title, Date, Relevant Pages, Place of Publication)					
AM	BB	Michael B. Kleiner et al., "High Performance Forced Air Cooling Scheme Employing Microchannel Heat Exchangers", 1995, IEEE Transactions on Components, Packaging, and Manufacturing Technology-Part A, Vol. 18, No. 4, pages 795-804.			
AM	BC	Jerry K. Keska Ph. D. et al., "An Experimental Study on an Enhanced Microchannel Heat Sink for Microelectronics Applications", EEP-Vol. 26-2, Advances in Electronic Packaging, 1999, Vol. 2, pages 1235-1259.			
AM	BD	Shung-Wen Kang et al., "The Performance Test and Analysis of Silicon-Based Microchannel Heat Sink", July 1999, Terahertz and Gigahertz Photonics, Vol. 3795, pages 259-270.			
	BE	Joseph C. Tramontana, "Semiconductor Laser Body Heat Sink", Xerox Disclosure Journal, Vol. 10, No. 6, November/December 1985, pages 379-381.			
	BF	Sarah Arulanandam et al., "Liquid transport in rectangular microchannels by electroosmotic pumping", Colloid and Surfaces A: Physicochemical and Engineering Aspects 161 (2000), pages 89-102.			
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	BJ	James P. Slupe et al., "An idea for maintaining a stable thermal environment for electronic devices", Research Disclosure, August 2001, page 1312.			
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	BL	"Thin Heat Pipe for Cooling Components on Printed Circuit Boards", IBM Technical Disclosure Bulletin, Vol. 34, No. 7B, December 1991, pages 321-322.			
	BM	R. C. Chu et al., "Process for Nucleate Boiling Enhancement", IBM Technical Disclosure Bulletin, Vol. 18, No. 7, December 1975, page 2227.			
	BN	J. Riseman, "Structure for Cooling by Nucleate Boiling", IBM Technical Disclosure Bulletin, Vol. 18, No. 11, April 1976, page 3700.			
	BO	"Integrally Grooved Semiconductor Chip and Heat Sink", October 1971, IBM Technical Disclosure Bulletin, Vol. 14, No. 5, page 1425.			
	BP	"Enhanced Cooling of Thermal Conduction Module", IBM Technical Disclosure Bulletin, Vol. 30, No. 5, October 1987, page 426.			
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	BY	W. J. Kleinfelder et al., "Liquid-Filled Bellows Heat Sink", IBM Technical Disclosure Bulletin, Vol. 21, No. 10, March 1979, pages 4125-4126.			
	BZ	R. P. Chrisfield et al., "Distributed Power/Thermal Control", IBM Technical Disclosure Bulletin, Vol. 22, No. 3, August 1979, pages 1131-1132.			
AM	CA	A. J. Arnold et al., "Heat Sink Design for Cooling Modules in a Forced Air Environment", IBM Technical Disclosure Bulletin, Vol. 22, No. 6, November 1979, pages 2297-2298.			
AM	CB	A. J. Arnold, "Structure for the Removal of Heat from an Integrated Circuit Module", IBM Technical Disclosure Bulletin, Vol. 22, No. 6, November 1979, pages 2294-2296.			
AM	CC	U. P. Hwang et al., "Cold Plate for Thermal Conduction Module with Improved Flow Pattern and Flexible Base", IBM Technical Disclosure Bulletin, Vol. 25, No. 9, February 1983, page 4517.			
AM	CD	K. C. Gallagher et al., "Cooling System for Data Processor with Flow Restrictor in Secondary Loop to Limit Bypass-Cooling Water Flow", IBM Technical Disclosure Bulletin, Vol. 26, No. 5, October 1983, page 2658.			
Examiner:			Date Considered:		
EXAMINER: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.					

Michael B. Kleiner

6-87-05

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OTHER DOCUMENTS (Including Author, Title, Date, Relevant Pages, Place of Publication)

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<i>TM</i>	CF	J. M. Eldridge et al., "Heat-Pipe Vapor Cooling Etched Silicon Structure", IBM Technical Disclosure Bulletin, Vol. 25, No. 8, January 1983, pages 4118-4119.
<i>TM</i>	CG	J. R. Skobern, "Thermoelectrically Cooled Module", IBM Technical Disclosure Bulletin, Vol. 27, No. 1A, June 1984, page 30.
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	CQ	A. H. Johnson, "Device Cooling", IBM Technical Disclosure Bulletin, Vol. 20, No. 10, March 1978, pages 3919-3920.
	CR	A. L. Pacuzzo et al., "Integrated Circuit Module Package Cooling Structure", IBM Technical Disclosure Bulletin, Vol. 20, No. 10, March 1978, pages 3898-3899.
	CS	R. D. Durand et al., "Flexible Thermal Conductor for Electronic Module", IBM Technical Disclosure Bulletin, Vol. 20, No. 11A, April 1978, page 4343.
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	CU	J. A. Dorler et al., "Temperature Triggerable Fluid Coupling System for cooling Semiconductor Dies", IBM Technical Disclosure Bulletin, Vol. 20, No. 11A, April 1978, pages 4386-4388.
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Examiner:

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Paul McKeon 6-27-05

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OTHER DOCUMENTS (Including Author, Title, Date, Relevant Pages, Place of Publication)		
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	DU	Haim H. Bau, <u>Optimization of conduits' shape in micro heat exchangers</u> , December 10, 1997, International Journal of Heat and Mass Transfer 41 (1998), pages 2717-2723.
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	DZ	S. F. Choquette, M. Faghri et al., <u>OPTIMUM DESIGN OF MICROCHANNEL HEAT SINKS</u> , 1996, DSC-Vol. 59, Microelectromechanical Systems (MEMS), ASME 1996, pages 115-126.
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	EB	J. M. Cuta et al., <u>FORCED CONVECTION HEAT TRANSFER IN PARALLEL CHANNEL ARRAY MICROCHANNEL HEAT EXCHANGER</u> , 1996, PID-Vol. 27 HTD-Vol. 338, Advances in Energy efficiency, Heat/Mass Transfer Enhancement, ASME 1996, pages 17-23.
	EC	K. Fushinobu et al., <u>HEAT GENERATION AND TRANSPORT IN SUB-MICRON SEMICONDUCTOR DEVICES</u> , 1993, HTD-Vol. 253, Heat Transfer on the Microscale, ASME 1993, pages 21-28.
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TM	EF	Koichiro Kawano et al., <u>Micro Channel Heat Exchanger for Cooling Electrical Equipment</u> , HTD-Vol. 361-3/PID-Vol. 3, Proceeding of the ASME Heat Transfer Division - Volume 3, ASME 1998, pages 173-188.
TM	EG	Chad Harris et al., <u>Design and Fabrication of a Cross Flow Micro Heat Exchanger</u> , December 2000, Journal of Microelectromechanical Systems, Vol. 9, No. 4, pages 502-508.

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Michael W. Kucera 6-27-05

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OTHER DOCUMENTS (Including Author, Title, Date, Relevant Pages, Place of Publication)					
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JM	EI	Pei-Xue Jiang et al., <u>Thermal-hydraulic performance of small scale micro-channel and prous-media heat-exchangers</u> , 2001, International Journal of Heat and Mass Transfer 44 (2001), pages 1039-1051.			
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	EO	T.S. Ravigururajan et al., <u>Liquid Flow Characteristics in a Diamond-Pattern Micro-Heat-Exchanger</u> , DSC-Vol. 59 Microelectromechanical Systems (MEMS), ASME 1996, pages 159-166			
	EP	T.S. Ravigururajan, <u>Impact of Channel Geometry on Two-Phase Flow Heat Transfer Characteristics of Refrigerants in Microchannel Heat Exchangers</u> , May 1998, Journal of Heat Transfer, Vol. 120, pages 485-491			
	EQ	J. Pfahler et al., <u>Liquid Transport in Micron and Submicron Channels</u> , March 1990, Sensors and Actuators, A21-A23 (1990), pages 431-434.			
	ER	Kenneth Pettigrew et al., <u>Performance of a MEMS based Micro Capillary Pumped Loop for Chip-Level Temperature Control</u> , 2001, The 14 th IEEE International Conference on Micro Electro Mechanical Systems, pages 427-430.			
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	FF	D. Jed Harrison et al., <u>Electroosmotic Pumping Within A Chemical Sensor System Integrated on Silicon</u> , Session C9 Chemical Sensors and Systems for Liquids, June 26, 1991, pages 792-795.			
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Examiner:		<i>[Signature]</i>		Date Considered: 6-27-05	
EXAMINER: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.					

FORM PTO-1449 (Modified)		U.S. Department of Commerce Patent and Trademark Office		Attorney Docket No.: COOL-01800	Serial No.: 10/698,304
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use Several Sheets If Necessary)				Applicants: Kenneth Goodson et al.	
				Filing Date: October 30, 2003	Group Art Unit: 1312
(37 CFR § 1.98(b))					
OTHER DOCUMENTS (Including Author, Title, Date, Relevant Pages, Place of Publication)					
<i>TM</i>	FJ	W.E. Morf et al., <u>Partial electroosmotic pumping in complex capillary systems Part 1: Principles and general theoretical approach</u> , October 16, 2000, <u>Sensors and Actuators B 72 (2001)</u> , pages 266-272.			
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	GG	Chun Yang et al., <u>Modeling forced liquid convection in rectangular microchannels with electrokinetic effect</u> , 1998, <u>International Journal of Heat and Mass Transfer</u> 41 (1998), pages 4229-4249.			
	GH	Arel Weisberg et al., <u>Analysis of microchannels for integrated cooling</u> , 1992, <u>Int. J. Heat Mass Transfer</u> , Vol. 35, No. 10, pages 2465-2473.			
<i>TM</i>	GI	Roger S. Stanley et al., <u>Two-Phase Flow in Microchannels</u> , 1997, <u>DSE-Vol. 62/HTD-Vol. 354, MEMS</u> , pages 143-152.			
<i>TM</i>	GJ	B. X. Wang et al., <u>Experimental investigation on liquid forced-convection heat transfer through microchannels</u> , 1994, <u>Int. J. Heat Mass Transfer</u> , Vol. 37 Suppl. 1, pages 73-82.			
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Examiner: <i>[Signature]</i>		Date Considered: <i>6-27-05</i>			
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use Several Sheets if Necessary)				Applicants: Kenneth Goodson et al.	
(37 CFR § 1.98(b))				Filing Date: October 30, 2003	Group Art Unit: 1312
OTHER DOCUMENTS (Including Author, Title, Date, Relevant Pages, Place of Publication)					
JM	GL	Gokturk Tune et al., <u>Heat transfer in rectangular microchannels</u> , 2002, Int. J. Heat Mass Transfer, 45 (2002), pages 765-773.			
JM	GM	D. B. Tuckerman et al., <u>High-Performance Heat Sinking for VLSI</u> , 1981, IEEE Electron Device Letters, Vol. EDL-2, No. 5, pages 126-129.			
1	GN	Bengt Sundén et al., <u>An Overview of Fabrication Methods and Fluid Flow and Heat Transfer Characteristics of Micro Channels</u> , pages 3-23.			
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JM	GV	Jac-Mo Koo et al., "Modeling of Two-Phase Microchannel Heat Sinks for VLSI Chips", Mech. Eng. Depart. of Stanford University, pp. 422-426.			
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Examiner: <i>David M. Krumm</i>		Date Considered: <i>6-27-05</i>			
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FORM PTO-1449
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Patent and Trademark Office

Attorney Docket No.: COOL-01800

Serial No.: 10/698,304

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Use Several Sheets If Necessary)

Applicants: Kenneth Goodson et al.

(37 CFR § 1.98(b))

Filing Date: October 30, 2003

Group Art Unit: 3743

U.S. PATENT DOCUMENTS

Examiner Initials		Serial / Patent Number	Issue Date	Applicant / Patentee	Class	Subclass	Filing Date
TM	AA	6,632,719 B1	10/14/03	DeBoer et al.	438	381	08/31/00
	AB						
	AC						
	AD						
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	BH						

Examiner: *David M. Sullivan*Date Considered: *6-27-05*

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Patent and Trademark Office

Attorney Docket No.: COOL-01800

Serial No.: 10/698,304

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Use Several Sheets If Necessary)

Applicants: Kenneth Goodson et al.

(37 CFR § 1.98(b))

Filing Date: October 30, 2003

Group Art Unit: 3743

U.S. PATENT DOCUMENTS

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<i>TM</i>	AA	5,179,500	01/12/93	Koubek et al.	361	385	04/02/91
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ELECTRONIC INFORMATION DISCLOSURE STATEMENT

Electronic Version v18

Stylesheet Version v18.0

Title of Invention	METHOD AND APPARATUS FOR ACHIEVING TEMPERATURE UNIFORMITY AND HOT SPOT COOLING IN A HEAT PRODUCING DEVICE
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Application Number : 10/698304
Confirmation Number: 1389
First Named Applicant: Kenneth Goodson
Attorney Docket Number:
Art Unit:
Examiner:
Search string: (5316077 or 6167948 or 6606251 or 20030062149).pn



Certification: This Information Disclosure Statement was submitted under the following conditions, which satisfies the requirement under 37 CFR 1.97(e). The filer certified:

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement.

US Patent Documents

Note: Applicant is not required to submit a paper copy of cited US Patent Documents


init	Cite.No.	Patent No.	Date	Patentee	Kind	Class	Subclass
<i>TM</i>	1	5316077	1994-05-31	Reichard		<i>/</i>	<i>/</i>
<i>TM</i>	2	6167948	2001-01-02	Thomas	B1	<i>/</i>	<i>/</i>
<i>TM</i>	3	6606251	2003-08-12	Kenny, Jr. et al.	B1	<i>/</i>	<i>/</i>

US Published Applications

Note: Applicant is not required to submit a paper copy of cited US Published Applications

init	Cite.No.	Pub. No.	Date	Applicant	Kind	Class	Subclass
<i>TM</i>	1	20030062149	2003-04-03	Goodson et al.	A1	<i>/</i>	<i>/</i>

Signature

	Examiner Name	Date
		6-27-05



ELECTRONIC INFORMATION DISCLOSURE STATEMENT

Electronic Version v18

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Title of
Invention

METHOD AND APPARATUS FOR ACHIEVING
TEMPERATURE UNIFORMITY AND HOT SPOT COOLING
IN A HEAT PRODUCING DEVICE

Application Number: 10/698304



Confirmation Number: 1389

First Named Applicant: Kenneth Goodson

Attorney Docket Number:

Search string: (3948316 or 5161089 or 5228502 or 5239443
or 5265670 or 5978220 or 5993750 or
6729383),pn.

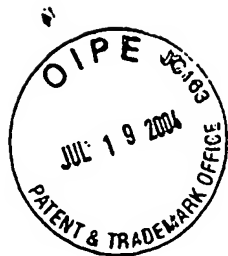
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That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement.

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TM	1	3948316	1976-04-06	Souriau			
TM	2	5161089	1992-11-03	Chu et al.			
TM	3	5228502	1993-07-20	Chu et al.			
TM	4	5239443	1993-08-24	Fahey et al.			
TM	5	5265670	1993-11-30	Zingher			
TM	6	5978220	1999-11-02	Frey et al.			
TM	7	5993750	1999-11-30	Ghosh et al.			
TM	8	6729383	2004-05-04	Cannell et al.	B1		



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Electronic Filing System (EFS) Data
Electronic Patent Application Submission
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EFS ID: 64829
Application ID: 10698304
Title of Invention: METHOD AND APPARATUS FOR
ACHIEVING TEMPERATURE
UNIFORMITY AND HOT SPOT
COOLING IN A HEAT PRODUCING
DEVICE
First Named Inventor: Kenneth Goodson
Domestic/Foreign Application: Domestic Application
Filing Date: 2003-10-30
Effective Receipt Date: 2004-07-19
Submission Type: Information Disclosure
Statement
Filing Type:
Confirmation number: 1389
Attorney Docket Number: NONE


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**TRANSMITTAL**

Electronic Version v1.1
Stylesheet Version v1.1.0

Title of Invention	METHOD AND APPARATUS FOR ACHIEVING TEMPERATURE UNIFORMITY AND HOT SPOT COOLING IN A HEAT PRODUCING DEVICE									
<p>Application Number: 10/698304 </p> <p>Date: 2003-10-30</p> <p>First Named Applicant: Kenneth Goodson</p> <p>Confirmation Number: 1389</p> <p>Attorney Docket Number:</p>										
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Application Number: 10/698304



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Signature

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